	Type	L #	Hits	Search Text	DBs	Time Stamp
1	IS&R	L1	0	("10048205").PN.	US-PGPUB	2003/04/17 16:52
2	BRS	L2	0	10/048205	USPAT	2003/04/17 16:52
3	BRS	L3	0	10/048205	US-PGPUB	2003/04/17 16:52
4	BRS	L4	11	Gambale	US-PGPUB	2003/04/17 16:56
5	BRS	L5	1616	helical$ and spring and barb$	USPAT	2003/04/17 17:32
6	BRS	L6	42	helical$ same spring and barb$ and prosthes$	USPAT	2003/04/17 17:33
7	BRS	L7	56	helical$ same (spring or coil) and barb$ and prosthes$	USPAT	2003/04/17 17:35
8	BRS	L8	0	TMR and coil and prosthes$ and barbs	USPAT; DERWENT	2003/04/17 17:36
9	BRS	L9	1	transmyo$ and coil and prosthes$ and barbs	USPAT; DERWENT	2003/04/17 17:37

	Comments	Error Definition	Errors
1			0
2			0
3			0
4			0
5		Truncation overflow.	1
6		Truncation overflow.	1
7		Truncation overflow.	1
8			0
9			0

	Type	L #	Hits	Search Text	DBs	Time Stamp
10	BRS	L10	88	tissue and coil same barbs	USPAT	2003/04/17 17:37
11	BRS	L11	26	tissue and coil adj9 barbs	USPAT	2003/04/17 17:44
12	BRS	L12	0	tissue and coil adj9 barbs	EPO; JPO	2003/04/17 17:45
13	BRS	L13	0	tissue and coil adj9 barbs	DERWENT	2003/04/17 17:45
14	BRS	L14	242	tissue and coil same cross adj3 section same shape	USPAT; DERWENT	2003/04/17 18:00
15	BRS	L15	8	("1230603" | "1468074" | "2777718" | "3515027" | "4040326" | "5312214" | "5536126" | "6276883").PN.	USPAT	2003/04/17 17:50
16	BRS	L22	0	6494657.URPN.	USPAT	2003/04/17 17:50
17	BRS	L23	0	6494657.URPN.	USPAT	2003/04/17 17:51
18	BRS	L24	19	tissue and coil same (barbs or barbed) and prosthes$	USPAT; DERWENT	2003/04/17 18:03

	Comments	Error Definition	Errors
10			0
11			0
12			0
13			0
14			0
15			0
16			0
17			0
18			0

US-PAT-NO: 6019779

DOCUMENT-IDENTIFIER: US 6019779 A

TITLE: Multi-filar coil medical stent

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These single filar stents are formed of a single filar wire having a circular **cross-section** or a rectangular or "ribbon shaped" **cross-section** (although other **cross-section shapes** are suggested in the above-referenced '600 patent) terminating with enlarged "ball tips" at the wire ends. The ribbon shaped wire is preferred because it can be formed of many desirable materials, e.g., superelastic or pseudoelastic alloys such as disclosed in U.S. Pat. No. 5,597,378 to Jervis, and results in a "low profile" or thin stent scaffolding that depends on the ribbon shaped thickness. In addition, ribbon shaped wire can achieve stent strength equivalent to stents of the same stent diameter and **coil** pitch made of round wire but employing a thickness that is thinner than the round wire diameter, thus yielding smaller strains when wound down. The ribbon shaped wire can be therefore wound down to a smaller diameter about a stent delivery catheter without exceeding its strain limit and suffering plastic deformation than the comparable circular **cross section** wire. If the strain is too large, the material will experience plastic deformation to such an extent that the stent will not recover to the intended length and diameter dimensions following release and deployment.

The **coil** filars of the multi-filar stent embodiments of the present

invention are preferably formed in a rectangular cross-section of a nickel-titanium, superelastic, shape memory, Nitinol.RTM. alloy but could be made of other bio-compatible materials, e.g., stainless steel, Elgiloy.RTM. alloy, polymers, or bio-absorbable compounds. Moreover, they can be coated with other metals or with polymers, drugs or radioactive compounds or covered by an expandable tube of a bio-compatible elastomer, e.g., silicone rubber or a folded Dacron.RTM. fabric tube, that expands or straightens out as the stent diameter and length increases to form a fluid impervious or pervious graft.

FIGS. 1-3 show a bi-filar open coil stent 10 formed in accordance with the present invention of first and second coils 15 and 20 which are attached together at attachment junctions of the coil ends to form first or proximal and second or distal, stent ends 25 and 30, respectively. The first and second coils 15 and 20 are preferably formed of a nickel-titanium, superelastic, shape memory, Nitinol.RTM. alloy having a rectangular or ribbon shaped cross-section.

Additional coils can be interleaved into multi-filar open coil stents of the types depicted in FIGS. 1-5. The overall stent length 210 can range from 10 mm to 200 mm, and the unrestrained stent diameter 60 can range from 2 mm to 30 mm. The coil spacing 40 between adjacent coils 15 and 20 or 15, 20 and 125 can be fairly wide or narrow in a range of 0 mm to 20 mm. Preferably, the coils 15, 20, 125 are formed in rectangular cross-section and from a shape memory material e.g., superelastic or pseudoelastic alloys such as disclosed in the above-referenced '378 patent in order to sustain tight wrapping and substantial

reduction of the restrained stent outer diameter 215 about the stent delivery catheter 75 without substantial permanent deformation. In the bi-filar embodiment, the ribbon shaped, coil wire preferably has a thickness of about 0.15 mm to 0.40 mm and a width of about 0.30 mm to 5.00 mm.

The depiction in FIGS. 6-9 of these multi-filar closed coil stents is schematic and exaggerated for effect. The ribbon shaped cross section coils 135, 140 and 170 can be narrower and formed so that their edges contact one another in the deployed stent state as shown in FIGS. 6 and 8 or so that there is a slight spacing between their adjacent coil turn edges. Alternatively, the cross-section of each coil 135, 140, 170 can be in a stepped shape so that the adjacent coil turn edges can partially overlap one another in the deployed or released states of FIGS. 6 and 8.

FIG. 10 is a side view of a manner of grasping and removing the above-described stent embodiments and equivalents thereto, e.g. bi-filar open coil stent 10 for example, after it has been released into a body lumen 180 using the stent delivery system. Using endoscopy, a stent retrieval catheter 185 is introduced to the site, typically proximal to the proximal end of the stent 10. A stent retrieval tool 200 having a snare loop or grasper 205 is introduced through the stent retrieval catheter lumen 195 and extended distally from lumen distal end opening 190. The illustrated grasper 205 is expanded and fitted over the coils 15 and 20 adjacent to or encompassing the proximal enlarged ball tip 65 and then tightened against the proximal stent end 25 to grasp it. The stent retrieval tool 200 is then retracted to pull stent 10 proximally through the stent retrieval catheter lumen 195. The coils of the

stent 10 are resilient enough to unwind and be drawn through the stent retrieval catheter lumen 195 without damaging the tissue wall of the body lumen 180. This system and method can be employed to retrieve any of the stents of the present invention from the enlarged ball tip at the common attachment junction of the coils of the stent.

a stent having a substantially tubular shape and an expanded stent length and expanded stent diameter in an expanded state formed of a plurality of coils each having a pre-determined coil cross-section and extending for a predetermined length between a first coil end and a second coil end and each wound in a common winding direction and having a common winding pitch through a substantial portion of the coil length intermediate the first and second coil ends, and with first end coupling means for coupling the plurality of first coil ends together at a first stent end and with second end coupling means for coupling the plurality of second coil ends together at a second stent end for cooperatively maintaining said plurality of coils in is an interleaved, multi-filar winding relationship providing the substantially tubular stent shape and maintaining substantially equal coil spacing between adjacent turns of the plurality of coils through a substantial portion of the lengths of the plurality of coils, said first end coupling means comprising a first enlarged tip attached to each of the first coil ends having a cross-section exceeding, in at least one direction, the combined cross-section of the plurality of coils attached together at the first stent end, and said second end coupling means comprising a second enlarged tip attached to each of the second coil ends, whereby the first coil ends are commonly coupled together

and the second coil
ends are commonly coupled together; and a

a stent having a substantially tubular shape and an expanded stent length
and expanded stent diameter in an expanded state formed of a plurality of coils
each having a pre-determined coil cross-section and extending for a
predetermined length between a first coil end and a second coil end and each
wound in a common winding direction and having a common winding pitch through a
substantial portion of the coil length intermediate the first and second coil
ends, and with first end coupling means for coupling the plurality of first
coil ends together at a first stent end for cooperatively maintaining said
plurality of coils in an interleaved, multi-filar winding relationship
providing the substantially tubular stent shape and maintaining substantially
equal coil spacing between adjacent turns of the plurality of coils through a
substantial portion of the lengths of the plurality of coils, said first end
coupling means comprising a first enlarged tip coupled to said common junction
having a cross-section exceeding, in at least one direction, the combined
cross-section of the plurality of coils attached together at the first stent
end, and a second enlarged tip attached to each of the second coil ends,
whereby the first coil ends are commonly coupled together and the second coil
ends are separated from one another; and

providing a stent having a substantially tubular shape and an expanded stent
length and expanded stent diameter in an expanded state formed of a plurality
of coils each having a pre-determined coil cross-section and extending for a
predetermined length between a first coil end and a second coil end and each

wound in a common winding direction and having a common winding pitch through a substantial portion of the coil length intermediate the first and second coil ends, and with first end coupling means for coupling the plurality of first coil ends together at a first stent end and with second end coupling means for coupling the plurality of second coil ends together at a second stent end for cooperatively maintaining said plurality of coils in an interleaved, multi-filar winding relationship providing the substantially tubular stent shape and maintaining substantially equal coil spacing between adjacent turns of the plurality of coils through a substantial portion of the lengths of the plurality of coils, said first end coupling means comprising a first enlarged tip attached to each of the first coil ends having a cross-section exceeding, in at least one direction, the combined cross-section of the plurality of coils attached together at the first stent end, and said second end coupling means comprising a second enlarged tip attached to each of the second coil ends, whereby the first coil ends are commonly coupled together and the second coil ends are commonly coupled together;

providing a stent having a substantially tubular shape and an expanded stent length and expanded stent diameter in an expanded state formed of a plurality of coils each having a pre-determined coil cross-section and extending for a predetermined length between a first coil end and a second coil end and each wound in a common winding direction and having a common winding pitch through a substantial portion of the coil length intermediate the first and second coil ends, and with first end coupling means for coupling the plurality of first coil ends together at a first stent end for cooperatively

maintaining said
plurality of **coils** in an interleaved, multi-filar winding relationship
providing the substantially tubular stent **shape** and maintaining substantially
equal **coil** spacing between adjacent turns of the plurality of **coils** through a
substantial portion of the lengths of the plurality of **coils**, said first end
coupling means comprising a first enlarged tip coupled to said common junction
having a **cross-section** exceeding, in at least one direction, the combined
cross-section of the plurality of **coils** attached together at the first stent
end, and a second enlarged tip attached to each of the second **coil** ends,
whereby the first **coil** ends are commonly coupled together and the second **coil**
ends are separated from one another;